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Phytoestrogens as galactagogues in human and dairy cattle

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Abstract

The production of milk in the mother's body is nature's biggest gift. After birth, an adequate amount of milk secretion is very important for the proper nutrition of the baby. Those substances that overcome the deficiency of milk secretion are called galactagogues. There are many such plants in nature whose use can increase lactation by stimulating milk production not only in humans but also in dairy animals without any side effects. Medicines used to promote lactation contain many active ingredients whose identification is extremely important. In the presented research paper, herbal medicines and their phytoestrogenic chemicals that promote lactation in humans and dairy animals have been focused on and reviewed. We have described 23 herbs belonging from 17 families used as galactagogues and also discussed about myths and facts about them.

Keywords: Galactagogues, lactation, milk secretion, dairy animals, phytoestrogen

1. Introduction

Galactagogues are substances that stimulate the mammary glands in the mother's body to secrete milk. Breastfeeding after birth is very important for a healthy baby. In modern times, women are turning away from breastfeeding, one of the main reasons for which is the desire to keep their bodies shapely. If the process of lactation does not happen properly in the body, then this tendency gets further encouraged. Mother's milk is like nectar for the child. Both nutritional and non-nutritional factors are responsible for milk production. Non-nutritional factors include health, endocrinology, climate, lifestyle, etc. There are both natural and synthetic types of galactagogues that induce, maintain, and promote milk production. Among the artificial ones, the main ones are domperidone, metoclopramide, chlorpromazine, sulpiride, etc. Although they also have many side effects. These mainly include cardiac arrhythmia, lethargy, sedation, gastrointestinal disorders, hypertension, facial seborrhoea, hyperhidrosis and even sudden death. Problems like lethargy, sedation and intestinal discomfort are also seen in those newborns who consume the milk of these mothers. Apart from these, insulin, cortisol, somatotropin, leptin, progesterone, estrogen, medroxyprogesterone, recombinant bovine somatotropin (rBST), thyrotropin releasing hormone (TRH) and oxytocin (Figure 1) play an important role in promoting lactation. rBST is the main galactagogue used in animals, which is directly adversely affects the health of the dairy animals.

Plants also contain many phytoestrogenic components that stimulate milk production in humans and animals. Phyto ingredients mainly found in fennel, fenugreek, asparagus, anise, milk thistle, goat's rue, ginger and garlic etc. stimulate lactation (Table 1). Many herbal preparations have also proven effective in this direction, which are being used in veterinary dairy industry and as human breastfeeding medicine. Plant-based substances called phytoestrogens function similarly to estrogen in the human body. Sesame seeds, flaxseeds, Fennel, etc. are among the plants that contain them.

1.1 Phytoestrogen's Function

1.1.1 Estrogen modulation: By binding to estrogen receptors, phytoestrogens can affect hormone balance and possibly lessen the symptoms of menopause.

The activity of phytoestrogens is also influenced by endogenous oestrogen levels. Endogenous oestrogen levels are linked to elevated blood pressure in women who are of reproductive age. In order to bind to oestrogen receptors and prevent oestrogen action, lignans will compete with endogenous oestrogen in this circumstance. However, the ovaries' endogenous oestrogen production is reduced during menopause. Lignans are weak forms of oestrogen when oestrogen levels are low (Poluzzi *et al.* 2014) ^[41].

1.1.2 Lactogenic effects: In breastfeeding mothers, phytoestrogens may assist boost milk supply. Nowadays, there is a desire for plant-derived oestrogens because hormone replacement therapy is risky and ineffective. Compounds from any plant that resemble ovarian and placental oestrogens and their active metabolites in structure or activity are known as phytoestrogens (Parihar *et al.* 2004) ^[37].

1.1.3 Redox regulation: The antioxidant qualities of phytoestrogens can aid in preventing oxidative stress and cell damage. Using electron spin resonance spectroscopy, plasma ferric-reducing ability, and trolox equivalent antioxidant capacity, Mitchell *et al.* assessed the antioxidant efficacy of phytoestrogens and found that cumestrol has more than twice the ferric reducing ability of isoflavones, but only about half the activity of quercetin, a well-researched flavonoid (Mitchell *et al.*, 1998) ^[35].

1.1.4 Cardiac wellness: Phytoestrogens may help prevent cardiovascular disease, lower blood pressure, and lower cholesterol. According to experimental research, phytoestrogens have positive effects on endothelial cells, vascular smooth muscle, and extracellular matrix. They also reduce arterial stiffness and have antiatherosclerotic effects through the production of NO. Other pathophysiologic vascular processes, including lipid profile (lowering LDL cholesterol levels), angiogenesis, inflammation, and tissue

damage from reactive oxygen species, may also be impacted by phytoestrogens. These effects may slow the advancement of atherosclerosis. (Wuttke *et al.*, 2002) ^[61].

1.1.5 Anti-tumor qualities: It has been demonstrated that phytoestrogens can stop the growth of cancer cells and cause apoptosis, or cell death, in several cancer forms. Increased DNA mutagenesis, cell proliferation, tissue vascularization, decreased apoptosis, immunological response, and other processes that may be regulated by oestrogens can all be linked to the malignant transformation of healthy cells and tumorigenesis. Phytoestrogens may influence these processes through both -independent and -dependent pathways on the oestrogen receptor (Rietjens, *et al.* 2023) ^[47].

1.1.6 Braincell protection: Plant estrogens may offer some defense against neurodegenerative illnesses like Parkinson's and Alzheimer's. There is potential for phytoestrogens to enhance cognitive brain function. There is some evidence that phytoestrogens may have an impact on cognitive functions, and that these effects may be sex-specific. However, because published studies and their findings differ, it is impossible to draw firm conclusions about how phytoestrogens affect the healthy brain's cognitive functions. (Sumien *et al.* 2013) ^[54].

1.1.7 Skeletal wellness: By preserving density in bones, phytoestrogens may lower the incidence of osteoporosis. One of the key factors promoting bone growth is oestrogen. It is hypothesised that a diet high in phytoestrogen can prevent osteoporosis and that their deficiency can encourage it. (Wuttke *et al.*, 2002) ^[61].

1.2 Food source of Phytoestrogen

Shatavari, Fenugreek, Blessed thistle, Anise, Hops, Dates, Sesame, Garlic, Papaya, Moringa, Barley, Goat's rue, etc are some sources of phytoestrogen.

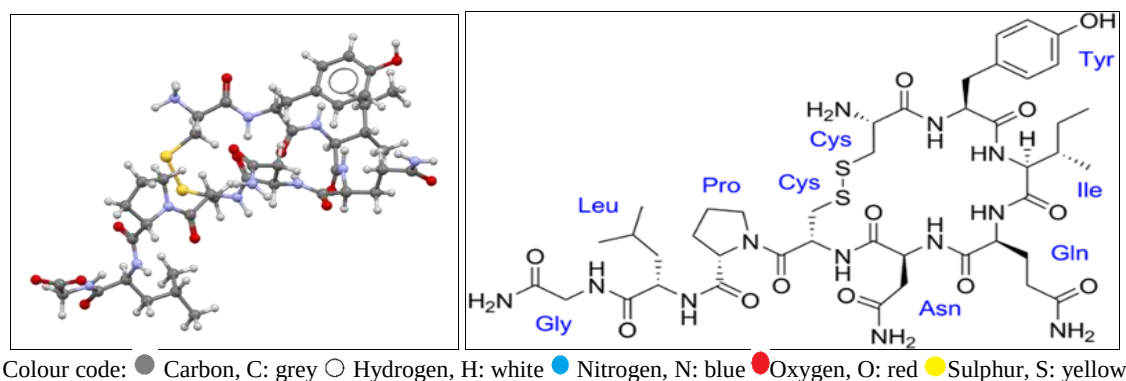


Fig 1: A commonly used Synthetic Galactogougues, Oxytocin Molecule (C₄₃H₆₆N₁₂O₁₂S₂)

Not only plants are used as natural galactagogue substances but synthetic galactagogue substances are also used in abundance. These mainly include Oxytocin, rBST (Recombinant Bovine Somatotropin), TRH (Thyrotropin Releasing Hormone) and medroxyprogesterone as hormone synthetic analogs, antiemetics metoclopramide and domperidone as dopamine antagonists, sulpiride and chlorpromazine as antipsychotics. rBST is the main galactagogue used for dairy cattles. At present, many herbal preparations are being used in human breastfeeding medicine and the veterinary dairy industry to promote lactation. With its use, there has been a significant increase in milk

production in women, goats, cows, and other milch species.

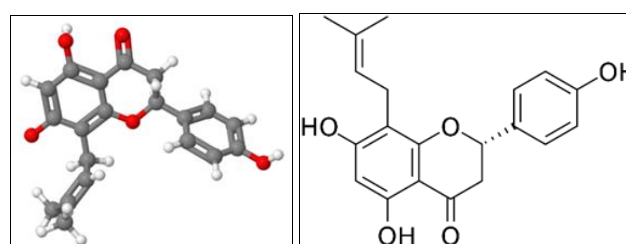


Fig 2: A Potent Natural Phytoestrogen, '8-Prenylnaringenin' Molecule (C₂₀H₂₀O₅)

3D image by JS mol

In this paper, natural alternatives are reviewed while reviewing the use of active galactagogue substances in human and veterinary medicine. By comparing, their effects have been highlighted. Myths associated with the use of galactagogues are also mentioned in this study.

2. Herbs as Natural Galactagogues

Numerous physiological processes are positively impacted by active phytochemical components. Numerous illnesses are treated using them. This explains why lactation improvement has benefited from the usage of numerous plants and the active substances derived from them. The natural galactagogues are arranged in a table here.

2.1 *Asparagus racemosus* (Shatavari)

Shatavarine I is found in *Asparagus racemosus* plant root tuber. Shatavari possesses various medicinal benefits like anti-ulcer, anti-tussive, adaptogenic, anti-bacterial, anti-protozoal, molluscicidal, anti-hepatotoxic, anti-neoplastic, anti-oxidative, immunomodulatory, and anti-lithia-tic activity in addition. Clinical studies have shown the positive effect of Shatavari on the milk yield of lactating mothers. Oral administration of the herb increased the levels of prolactin three times due to the steroidal saponins as shatavarins I-IV. An oral dosage of up to 64g/kg of Shatavari is considered safe for consumption (Rajni *et al.* 2024) ^[44]. However, an animal study found that the expansion of mammary glands, alveolar tissue, and acini associated with an increase in milk supply (Elemo *et al.* 2016) ^[14]. Consuming half a kilo of fresh asparagus root every day while milking increases the milk yield of buffaloes (Thakur *et al.* 2023) ^[56].

2.2 *Trigonella foenum graecum* (Fenugreek)

Diosgenin is present in the *Trigonella foenum graecum* plant seed. Fenugreek is one of the most popular galactagogues commonly used by the lactating mothers. The seeds of fenugreek stimulate hormone precursors leading to enhancement in the milk production. It is also thought that the increase in breast milk could be due to the presence of phytoestrogens and diosgenin contents in fenugreek. Fenugreek is most popularly used herbal galactagogue throughout the world. It is enlisted in the FDA's list of herbs usually considered safe. It has been found that fenugreek is a potent stimulator of breast milk production that appears to be safe for mother and baby. It is relatively easy to obtain, inexpensive and requires no major preparation (Ravi, *et al.* 2020) ^[46]. Among the several active substances identified in fenugreek is diosgenin, which may be the main one linked to lactation (Hale *et al.* 1998) ^[20]. Diosgenin has been shown in animal experiments to stimulate the growth of breast tissue (Humphrey *et al.* 2007) ^[23]. It is believed that the active ingredients in fenugreek function as hormone precursors, increasing the amount of milk produced (Finch *et al.* 2012) ^[16].

2.3 *Urtica dioica* (Stinging Nettle)

High Iron, Potassium, Omega 3 are found in leaves of *Urtica dioica* plant. Nettle is said to aid in lactation by supplying vital nutrients. It is believed that adding dried nettles to animal feed will increase the amount of milk that cows produce. However, if taken in strong quantities, the herb's astringent properties may theoretically lower milk production. Otherwise, using nettle during pregnancy or breastfeeding is not known to be harmful (RE Westfall *et al.* 2003) ^[60].

Table 1: List of Natural Galactagogues Plants

S. No.	Local name	Scientific name	Active compounds	Parts used (In Diet)	Doses	Ref.
1	Shatavari	<i>Asparagus racemosus</i> (Asparagaceae)	Shatavarine I	Root	Powder (10 g with milk per day)	41, 13, 52
2	Fenugreek	<i>Trigonella foenum graecum</i> (Fabaceae)	Diosgenin	Seed	Capsule (6 g daily)/Tea (50 g in 8 ounce s of water)	46, 20, 23, 16
3	Stinging Nettle	<i>Urtica dioica</i> (Urticaceae)	High Iron, Potassium, Omega 3	leaves	1.8g as Tea (1 cup, 2-3 times a day)/Capsule (600 mg thrice a day)/Tincture (2.5-5.0 ml thrice a day)	60
4	Milk Thistle	<i>Silybum marianum</i> (Asteraceae)	Silybin A & B, Silydianin, Silychristin	Seed	Infusion (12-15g daily)	56
5	Ginger	<i>Zingiber officinale</i> (Zingiberaceae)	Gingerol, Shogaol, Paradol, Zingerone	Rhizome	Capsule (500 mm per day)	1, 26, 15, 2, 28, 4, 8, 32
6	Oat	<i>Avena sativa</i> (Poaceae)	Globulin, Avenalin	Seed	100 g daily	9, 36
7	Barley	<i>Hordeum vulgare</i> (Triticeae)	Ploysaccharides	Seed	Beer	59, 11, 11, 13
8	Brown rice	<i>Oryza sativa</i> (Poaceae)	Thiamin (aka vitamin B1)	Seed	Cooked rice (1/2-1 cup per day)	46
9	Moringa	<i>Moringa oleifera</i> (Moringaceae)	Phytosterols, Prolactin, Flavonoids	Leaves	Capsule (250 mg), Tea (2 times a day)	17, 42, 22
10	Chickpeas	<i>Cicer arietinum</i> (Fabaceae)	High K,P,Mg,Ca	Seed	1.25 cup per day	31, 25, 22
11	Sesame	<i>Sesamum indicum</i> (Pedaliaceae)	High Calcium	Seed	Seed (1-2 teaspoon per day)	36
12	Fennel	<i>Foeniculum vulgare</i> (Apiaceae)	Anthole, Estragole	Seed oil	Oil (0.1-0.6 ml daily)	56, 22
13	Anise	<i>Pimpinella anisum</i> (Apiaceae)	Anthole, Estragole	Seed	Tincture Tea (3.5-7 g)	56, 3
14	Blessed Thistle	<i>Cnicus benedictus</i> (Asteraceae)	Sesquiterpene lactones, Triterpenoids	leaves, Upper stems	Capsule (2 g daily)	43,38
15	Goat's Rue	<i>Galega officinalis</i> (Fabaceae)	Kaempferol, Quercetin	Dried leaves	Tincture (1-2 ml, 2-3 times a day)	43, 14, 27
16	Garlic	<i>Allium sativum</i> (Amaryllidaceae)	Allicin, Vitamin C & B 6, Manganese	Cloves	Garlic flavoured milk 4 to 9 g, in capsule form daily	51, 21, 50, 33, 22
17	Papaya	<i>Carica papaya</i> (Caricaceae)	Carotene, Quercetin	Unripe fruit, Leaf	Leaf juice (800 mg leaves)	53, 5, 7, 49, 48
18	Alfalfa	<i>Medicago sativa</i> (Fabaceae)	High Calcium, Vitamin D2	Sprouted seeds, Shoot	Capsule (60 daily)	43,14
19	Almonds	<i>Prunus amygdalus</i> (Rosaceae)	High Calcium, Magnesium, Vitamin E	Seed	Juice (2 times per day)	22
20	Dates	<i>Phoenix dactylifera</i> (Aracaceae)	Iron, protein, fiber, glucose, vitamins, biotin, niacin, folic acid, minerals	Fruit	Date fruits (10 daily)	10, 45, 55
21	Red Raspberry	<i>Rubus idaeus</i> (Rosaceae)	Polyphenols	Leaves, Fruit	Tea or tincture (2.7gm daily)	43
22	Flaxseed	<i>Linum usitatissimum</i> (Linaceae)	Essential fatty acids	Seed Oil	Orally (20-30g daily)	29, 30, 39, 24
23	Hops	<i>Humulus lupulus</i> (cannabaceae)	8-prenylnaringenin (prenylated flavonoid)	Flowers or Strobiles	Dry extract (500mg daily)/Tea (1-2 cups)/Stout beer (1 bottle daily)	40, 34

Ref=References

2.4 *Silybum marianum* (Milk Thistle)

Silybin A & B, Silydianin, Silychristin are found in the seed of *Silybum marianum* plant. 60% of silybinin, which is mostly present in fruits and seeds, is the main component of silymarin. Numerous studies have demonstrated that the bioactive ingredient silymarin, which is found in *Silybum*, improves the mammary glands activity and, consequently, milk production. An animal study examined the galactagogues' effects in pregnant and lactating rabbits using milk thistle seed extract that contained 70% silymarin. Tests using varying dosages of the extract-3, 6, and 9 mL/Kg diet- showed that the prolactin level rose as the dose increased. It was discovered that the seed extract raises hormone levels, which aids in milk production (Thakur, *et al.*, 2023) [56].

2.5 *Zingiber officinale* (Ginger)

Gingerol, Shogol, Paradol, Zingerone are found in Rhizome of *Zingiber officinale* plant. According to (Jubouri *et al.* 2012) [1], adding ginger to cows' diets greatly boosts milk output and its constituents. According to (Jolad *et al.* 2005) [26], dried ginger contains more gingerols than fresh ginger, which are byproducts of dehydration (Fahim *et al.* 2022) [15]. When ginger was added to 60 g/kg of concentrate diet for five months, it was found to improve milk output and milk contents of solids rather than fat, protein, or lactose in nursing Iraqi goats (Musodi *et al.* 2019) [2]. Ginger's ability to enhance milk production may be the cause of the notable rise in monthly milk production (Kanjapothy *et al.* 1987) [28], because it includes active substances that improve digestion and nutrition (Andrew *et al.* 2003) [4]. More milk production results from ginger's ability to improve the absorption of vital nutrients (Belew, *et al.* 2006; Mahmoud *et al.*, 2020) [8, 32]. By preventing the formation of harmful microbes, ginger enhances the state of the gastrointestinal environment and increases milk production (Belew *et al.*, 2006) [8].

2.6 *Avena sativa* (Oats)

Globulin, Avenalin are found in the seed of *Avena sativa* plant. A cup of oats is a healthy and easy way to increase the mother's milk production. According to (Bonyata, *et al.* 2017) [9], iron, which is plentiful in oats, can improve milk production and lessen maternal anemia. Oats have long been utilized as a galactagogue in various cultures. Oats For nursing moms, whole grains are incredibly nourishing. These possess characteristics that control the hormones that produce breast milk. Consequently, consuming whole grains can boost the production of breast milk. Numerous vital micronutrients, such as vitamin E, vitamin B6, iron, folic acid, zinc, copper, and magnesium, are found in oats, these nutrients can promote the health of the newborn through breast milk and aid in the healing process after giving birth (Neelofer *et al.* 2021) [36].

2.7 *Hordeum vulgare* (Barley)

The seeds of the plant *Hordeum vulgare* contain polysaccharides. B-glucan, lemon balm, and barley malt can all act as galactagogues for mothers of premature babies who have trouble producing enough milk (Wesolowska *et al.*, 2021) [59]. In several cultures, moms utilize barley, a supposedly galactagogue, to improve their milk production. A polysaccharide in barley may raise serum prolactin, according to some animal research (Choudhari *et al.* 1989) [11]. Because barley is a galactagogue that increases nursing women's milk production, it also has a significant impact on maternal health

(Aurangzeb *et al.* 2024) [6]. Although barley allergies are uncommon, mothers with celiac disease are recommended to avoid barley, which is used by mothers in many cultures to improve their milk supply [13].

2.8 *Oryza sativa* (Brown rice)

Thiamin (aka vitamin B1) is found in the seed of *Oryza sativa* plant. According to a study that was published in the Clinical Epidemiology and Global Health, brown rice has been shown to improve the supply of breast milk. It contains substances that are known to promote lactation and increase nursing moms' supply of breast milk. Its nutrition index has also been shown to naturally improve the spirits of nursing moms (Ravi *et al.* 2020) [46].

2.9 *Moringa oleifera* (Moringa)

Phytosterols, Prolactin, Flavonoids are present in the leaves of *Moringa oleifera* plant. The *Moringa oleifera* group's exclusive breastfeeding rate at six months met the WHO's targets. Consequently, the leaf of *Moringa oleifera* can be utilized as a galactagogue herb to boost breast milk production (Fungtammasan, *et al.* 2022) [17]. Galactagogues, which are found in moringa leaves, also enhance the quantity of excess food. Breast milk can be produced from moringa leaves. Moringa leaves contain prolactin. Its leaf extract is a potent lactagogue that raises the production of breast milk (Puspitasari *et al.* 2022) [42]. In addition to protein, moringa leaves are a great source of minerals like iron and vitamins B6, C, and riboflavin. According to a research by the University of the Philippines' Department of Pediatrics, nursing moms who took moringa capsules reported significantly more breast milk [22].

2.10 *Cicer arietinum* (Chickpea)

High Potassium, Phosphorus, Magnesium, Calcium are found in seeds of *Cicer arietinum* plant. Chickpea is a good source of important vitamins such as riboflavin, niacin, thiamine, folate and the vitamin A precursor β -carotene (Kishor, *et al.* 2017) [31]. Chickpea is considered to be one of the best edible legumes that help in weight gain and appetite. It is traditionally used in cancer, liver, kidney, and lung diseases and it can increase libido and increase milk production. Can increase (Javan, *et al.* 2017) [25]. It functions as a galactagogue, mimicking estrogen, and is primarily in charge of bringing up the production of breast milk [22].

2.11 *Sesamum indicum* (Sesame)

High calcium is present in the seed of *Sesamum indicum* plant. Black sesame seeds are proven to help nursing moms produce more milk. As a lactogenic food, sesame seeds aid in the development and enhancement of breast milk production. Some of the effects of sesame seeds on breast milk may be explained by their high calcium content and beneficial polyunsaturated fats, omega-6 fatty acids, and minerals. In addition to providing a considerable amount of iron, sesame seeds have estrogen-like plant qualities (Neelofer *et al.* 2021) [36].

2.12 *Foeniculum vulgare* (Fennel)

Anthole, Estragole are found in seed of *Foeniculum vulgare* plant. The main bioactive components of the essential oil extracted from fennel seeds are anethole (50-60%) and fenchone (15-20%). The extracted oil is chiefly comprised of (E)-anethole, (Z)-anethole, and α -thujone with proteins (14-

22%) and fat content (12-18%) (Thakur, *et al.*, 2023) ^[56]. Prolactin found in fennel plays an important role in milk production during breastfeeding. The fennel seeds used to the lactation bakes are an essential component of your diet as a nursing mother. According to a wealth of study, fennel seeds are the cause of the traditionally used milk boosters' increased milk volume, fat content, and consequent weight gain in babies ^[22].

2.13 *Pimpinella anisum* (Anise)

Anthole, Estragole are found in the seed of *Pimpinella anisum* plant. Star anise has strong estrogenic action in rats study agrees with anti-estrogenic, progestational, and anti-progestational properties. Estrogens found in star anise promote the milk duct system to expand and boosts breast milk production and the prolactin hormone level (Thakur, *et al.*, 2023) ^[56]. Numerous qualities, including antioxidant, antibacterial, carminative, expectorant, antiseptic, antispasmodic, and oestrogenic action, have been identified in extracts and essential oils derived from this plant. The herb has also been used in traditional medicine as a galactagogue, aphrodisiac, and to relieve menstruation pain (Anastasopoulou *et al.*, 2020) ^[3].

2.14 *Cnicus Benedictus* (Blessed Thistle)

Sesquiterpene lactones, Triterpenoids are present in the leaves and upper stems of *Cnicus Benedictus* plant. One of the best galactagogue herbs is the dried aerial portions, which are utilized as a galactagogue. It helps reduce moderate kinds of postpartum depression and increases breast milk. It is believed to improve the flow of milk by increasing blood flow to the mammary glands (Rajagopal *et al.* 2016) ^[43]. The components of dried acryl are utilized as galactagogues. It is believed to increase employment by stimulating blood flow to the breast glands, which enhances milk output. Blessed thistle is the least harmful. Women's blessed thistle is a bitter herb that helps with digestive and liver issues. It affects hormone levels and improves and enriches milk supply (Patel *et al.* 2015) ^[38].

2.15 *Galega officinalis* (Goat's Rue)

Kaempferol, Quercetin are present in the dried leaves of *Galega officinalis* plant. Around the world, goat's rue is used extensively as a galactagogue. There aren't many scientific studies on goat's rue's effectiveness or safety for nursing moms or babies. Although goat's rue is generally well accepted, women using antidiabetic medications should exercise caution since it may result in hypoglycaemia (Rajagopal *et al.* 2016) ^[43]. Although no controlled human trials have demonstrated lactogenic efficacy, studies on animals have shown increased milk production. In animal husbandry, galega officinalis is frequently used to boost the milk output of goats, cows, and sheep (Elemo *et al.* 2016) ^[14]. It's possible that phytosterols like diosgenin, phenolic substances like kaempferol and quercetin, and phytochemicals with dopamine antagonistic properties like anethole contribute to the rise in Brest milk. Furthermore, natural antioxidants that have the ability to scavenge free radicals have demonstrated a variety of positive benefits on cattle's productivity (Kahkeshani N, *et al.* 2015) ^[27].

2.16 *Allium sativum* (Garlic)

Allicin, Vitamins C and B6, and Manganese ore found in the cloves of *Allium sativum* plant. (Sharma *et al.* 2014) ^[51] Allicin, a sulfur-containing component found in garlic, is

crucial for development because sulfur compounds can penetrate the placenta and reach the baby (Hidiroglou, *et al.* 1981) ^[21]. (Scheffler *et al.* 2019) ^[50] Breastfed children showed increased suckling activity and stayed attached to the mother's breast longer after their moms had eaten garlic (Mennella, *et al.* 1991) ^[33]. It is a famous galactagogue as well. Due to their developing taste for garlic, which is found in trace amounts in breast milk, babies drink milk for extended periods of time ^[22].

2.17 *Carica papaya* (Papaya)

Carotene, Quercetin are found in the unripe fruit and leaves of *Carica papaya* plant. *Carica papaya* is shrub belonging to family Caricaceae, widely cultivated in many tropical countries (Subenthiran *et al.* 2013, Arumuganathan *et al.* 1991) ^[53, 5]. Kandha tribe of Kandhamal district of Orissa used 20 gm root paste on breast or taken orally with raw milk to increase lactation (Behera *et al.* 2006) ^[7]. To encourage the lactation unripe cooked fruits are used by the warlis tribe of Maharashtra (Sayed *et al.* 2008) ^[49]. Ripen fruite of papaya contains the proteolytic enzymes papain and chymopapain encourage the lactation. Papaya fruit is "generally recognized as safe" as a food by the United State Food and Drug Administration. The papaya leaves extract hasgalactagogue property was taken to prove over deficient milk production with Quasi-experiment with Pretest Posttest design method with nonequivalent control group. Papaya leaves show increase in prolactin hormones level in a dose of 800mg (Sahu *et al.* 2022) ^[48].

2.18 *Medicago sativa* (Alfalfa)

They are present in the Sprouted seeds & Shoot of *Medicago sativa* plant. Alfalfa is the primary food source for dairy cows, horses, and goats. It is also thought to be a galactagogue, which helps nursing moms produce more breast milk. Alfalfa has been used for women's health for a very long time. For many years, nursing moms have been consuming it to aid in the production of breast milk. Alfalfa is regarded as safe and nutrient-dense when consumed in moderation. Alfalfa is harmless for the infant and does enter the breast milk (Rajagopal *et al.* 2016) ^[43]. The pituitary glands breast glandular tissue function is encouraged by *Medicago sativa* leaves. Because it includes a variety of minerals, including magnesium, phosphorus, potassium, zinc, vitamins A, C, E, and K, as well as essential and non-essential amino acids, *Medicago sativa* leaves have a rich nutritional profile (Elemo, *et al.* 2016) ^[14].

2.19 *Prunus amygdalus* (Almonds)

High Calcium, Magnesium, Vitamin Eare present in the seed of *Prunus amygdalus* plant. Nuts provide vital vitamins and minerals and are renowned for their high nutritious content. Almonds are used by nursing women to boost the quality of their breast milk, which includes a larger fat content, a naturally sweet flavor, and a higher volume of improved and flavorful breast milk ^[22].

2.20 *Phoenix dactylifera* (Dates)

Iron, protein, fiber, glucose, vitamins, biotin, niacin, folic acid, minerals are present in fruit of *Phoenix dactylifera* plant. Iron, protein, fiber, glucose, vitamins, biotin, niacin, folic acid, minerals like calcium, sodium, and potassium, and steroid alcohol and sterol compounds like cholesterol are all found in dates, and they can increase the amount of breast milk. Steroid alcohol is a precursor for the production of

estrogen and, in conjunction with progesterone; it contributes to lactation, the development of mammary ducts and alveoli, and the stimulation of the secretion of prolactin in small amounts. A total of 25 mothers received 10 dates per day for four weeks, while 23 mothers served as a control group. From the first to the second week and from the first to the fourth week, the moms who ate dates saw a significant rise in their breast milk supply of 11% and 23%, respectively. Similarly, in contrast to the control group, the levels of breast milk were noticeably larger (Cengel *et al.* 2024) ^[10]. In addition to being high in nutrients, date fruits also contain galactagogues, which improve the production of milk. Additionally, they are said to contain patuchin hormone, which is essential for lowering bleeding after childbirth and promoting uterine healing. This hormone effectively increases milk production by facilitating vascular movements around the mammary glands (Ramadhani *et al.* 2024) ^[45]. In addition to being a source of carbohydrates, proteins, and vitamins and minerals like vitamin B complex, vitamin C, vitamin K, calcium, phosphorus, magnesium, and potassium, palm dates also contain plant chemicals and important nutrients like carotenoids, polyphenols, especially phenolic acids, isoflavones, flavonoids, and tannins, which may increase milk volume. Palm dates also have a sweet taste due to their natural sugar content, primarily sucrose, which makes them a popular ingredient in galactagogue products because they enhance taste (Tanasinpi boon *et al.* 2021) ^[55].

2.21 *Rubus idaeus* (Red Raspberry)

Polyphenols are present in the leaves and fruits of *Rubus idaeus* plant. Galactagogues should never be used in place of assessment and guidance regarding variables that can be changed to influence milk output. Additionally, Red raspberry is a component of breastfeeding tincture and tea. As a uterine toner, it not only promotes the production of breast milk but also aids in the uterus's postpartum recovery (Rajagopal *et al.* 2016) ^[43].

2.22 *Linum usitatissimum* (Flaxseed)

Essential fatty acids are present in the seed oil of *Linum usitatissimum* plant. Goats' rumen may produce more acetic acid and less butyric acid as a result of the flaxseed treatment, which would boost milk output (Kholif and associates *et al.* 2014) ^[29]. Flaxseed has the highest percentage of n-3a-linolenic acid (54.4±4.7 g/100 g of total fatty acids), making it the most recommended of all oilseeds. (Kholif *et al.* 2016) ^[30] Shown that supplementing with 20 ml of linseed oil per day increased milk output. (Petit *et al.* 2004) ^[39] found that adding whole flax seeds to dairy cows' diets at a rate of 9.7% of dietary dry matter after calving enhanced milk output by 29% (Ibrahim *et al.* 2020) ^[24].

2.23 *Humulus lupulus* (Hops)

8-prenyl naringenin (prenylated flavonoid) is present in the flowers and strobiles of *Humulus lupulus* plant. For millennia, hop (*Humulus lupulus* L.) has been used to flavor and preserve beer. In addition to catechins with possible medicinal uses, this plant is abundant in phenolic acids, flavonoids, proanthocyanidins, prenylated chalcones, and flavanones. In the past, female hop pickers frequently experienced menstruation irregularities, and hop extract was found to be effective in lowering hot flashes linked to menopause in women. Following a successful bioassay-guided fractionation of hop extracts, Milligan *et al.* reported a new chemical, 8-prenyl naringenin (8-PN) [Fig. 2], in 1999 and presented the first proof of its significant estrogenic activity. Actually, this chemical was first discovered in hops in 1984, but it was subsequently ignored (Pohjanvirta, *et al.* 2022) ^[40]. Numerous investigations have confirmed the high estrogenic efficacy of 8-PN since its discovery by (Milligan *et al.* 1997) ^[34].

3. Myths and Facts about Galactagogues

Galactagogues have been used extensively to promote lactation and milk production, including synthetic substances and phytoestrogens. However, there are frequently misunderstandings and errors in the literature on these drugs. The purpose of this section is to dispel some of the most common myths and facts about synthetic galactagogues and phytoestrogens.

Table 2: Myths and Facts about Gaactagogues

S. No.	Myths	Facts	References
1	The only purpose of oxytocin is to induce labor.	Oxytocin is necessary for breastfeeding since it plays a critical function in lactation and milk letdown.	52
2	The only synthetic form of oxytocin is available.	Skin-to-skin contact, breast stimulation, and relaxation techniques can all increase the levels of the naturally occurring hormone oxytocin.	52
3	Anise is only utilized in cooking.	Anise is a phytoestrogen galactagogue that promotes breastfeeding and helps boost milk production.	18
4	Fennel is exclusively used in cooking.	Fennel is a phytoestrogen galactagogue that promotes lactation and helps boost milk production.	12
5	The use of blessed thistle is limited to stomach problems.	As a phytoestrogen galactagogue, blessed thistle can promote lactation and boost milk supply.	58
6	The only properties of fenugreek are galactagogue.	Fenugreek is a well-known galactagogue, but it also contains antioxidant and anti-inflammatory qualities.	43
7	Hormone levels are unaffected by flaxseed.	Lignans, which are found in flaxseed, have the ability to influence hormone levels and boost milk production.	57
8	Synthetic oestrogen is more powerful than isoflavones.	Although plant-based substances called isoflavones can mimic the actions of oestrogen in the body, they are typically far less potent than synthetic oestrogen.	19

4. Conclusion

In both dairy cattle and humans, phytoestrogens have demonstrated encouraging potential as galactagogues. Numerous studies have shown that these plant-derived substances enhance breastfeeding outcomes and increase milk production. It has been demonstrated that phytoestrogens such

lignans and isoflavones enhance human milk production and nursing outcomes, especially in moms with low milk supplies. Phytoestrogens have also been shown to lower the risk of reproductive problems and enhance milk output and composition in dairy calves. This work also indicate myths and facts about galactagogues.

The information now available indicates that phytoestrogens may be a helpful supplement to conventional breastfeeding support techniques, even though further study is required to completely comprehend the mechanisms by which these substances achieve their galactagogic effects. Furthermore, using phytoestrogens as galactagogues could provide a more sustainable and natural substitute for artificial hormones and other lactation aids.

To verify the effectiveness and safety of phytoestrogens as galactagogues in dairy cattle and humans, as well as to investigate their possible uses in other nursing animals, more research is required. However, the information that is now available indicates that phytoestrogens could be a useful tool in promoting lactation and enhancing the results of milk production in a number of situations.

5. Conflict of interest

None

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